

Assembly method creates robust pressure seal

Title: Sealing technique for hydropneumatic pressure vessel

Patent number: US5806705

Date: 15th September 1998

Inventors: Herald Jr. N, Molina Jr. CT, Murphy JC

Assignee: Essef Corporation

Need:

Pneumatic pressure vessels which incorporate an elastomeric flexible diaphragm to separate the interior of the tank into a compressible gas-containing chamber and a liquid-containing chamber are commonly used as accumulator tanks for the storage of water in a pressurised system.

A number of techniques have been employed to produce a durable tank that is permanently sealed against leakage and is economical to make. A particular problem faced by designers is how to provide a reliable seal between the pressure vessel and the diaphragm so that the separation of the liquid and the gas is maintained.

In previous designs the upper edge of the diaphragm is formed in the shape of a gasket or O-ring which is compressed between the parts of the pressure vessel during assembly. However, particularly in the case of metal pressure vessels, sharp edges can cut the diaphragm at the area of compression leading to the failure of the seal. In addition, pressure vessel assembly may require the parts to be welded together, resulting in heat being conducted to the diaphragm and again affecting the sealing performance.

Therefore, a need exists for assembling the pressure vessel sections using a heat fusion tech-

nique where a rim portion of the diaphragm is trapped between the assembled parts to form a seal.

Invention:

The present invention describes a hydro-pneumatic pressure vessel comprising a tank wall defining a cavity, which is divided into two pressure chambers by a flexible elastomeric diaphragm. The diaphragm has a radially extending rim that defines a seal.

The neck portion of the pressure vessel (Figure 1) has a flange (40), which constitutes the first sealing surface (42), and a rim portion, which constitutes the second sealing surface (44). While the cap (38) of the pressure vessel has a flange (46), with a third sealing surface (48) and a concentric groove (50) which defines the fourth sealing surface.

During the assembly of the pressure vessel the rim of the diaphragm is placed on the second sealing surface. The first and third sealing surfaces are then softened by applying a hotplate to each surface and the first and second wall portions (26 & 36) are clamped together until the first and third sealing surfaces fuse together. The second and fourth sealing surfaces are clamped together with the rim of the diaphragm compressed between; thereby, creating a seal.

Sealing system in Stirling engine

Title: Piston assembly for Stirling engine

Patent number: US5865091

Date: 2nd February 1999

Inventors: Domanski CE, Houtman WH, Ziph B

Assignee: STM Corporation

Need:

Since the Stirling engine was patented in 1817, it has been the subject of close scrutiny, but has had limited operations over the years. However, one of its potential applications is in automobiles as an engine power unit for hybrid electric applications. Unfortunately, due to the wide acceptance of spark ignition and diesel engines, a Stirling engine would have to exhibit significant advantages such as higher fuel efficiency and reliability, and lower manufacturing costs.

Fuel efficiency is a major concern for the future of motor vehicles. It is estimated that the ultimate thermal efficiency for the internal combustion engine is 20%. In contrast, the

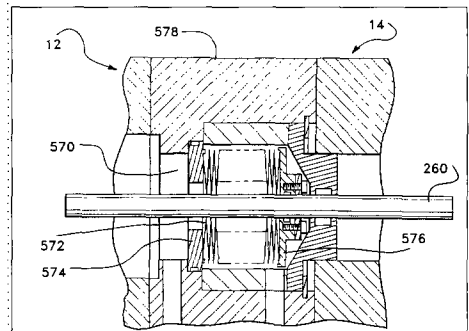


Figure 2a: The bellows rod seal incorporated into the Stirling engine.

Stirling engine's estimated thermal efficiency is between 40% to 50%.

Furthermore, environmental legislation demands continual reductions in exhaust pollution. Although catalytic converters and engine control significantly improve the quality of emissions, the high temperature intermittent combustion process in the internal combustion engine produces high levels of nitrogen oxide and carbon monoxide. This is not the case with the Stirling engine although high performance sealing is still required.

The major components of the Stirling engine are the drive case and the cylinder block. Currently, sliding rod seals are used to control the leakage of the high pressure engine working gas from the piston rod to the atmosphere. Although in many applications sliding contact rod seals provide adequate sealing, they will allow some fluid leakage, if only on a molecular level. Therefore, in applications where engines have a long operational life, a leak-free seal would be desirable.

Invention:

This patent describes an improved sealing system for the Stirling engine.

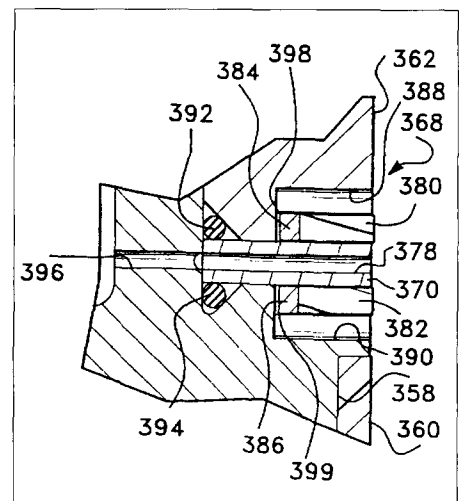


Figure 2b: The sealing system of the Stirling engine's piston assembly.

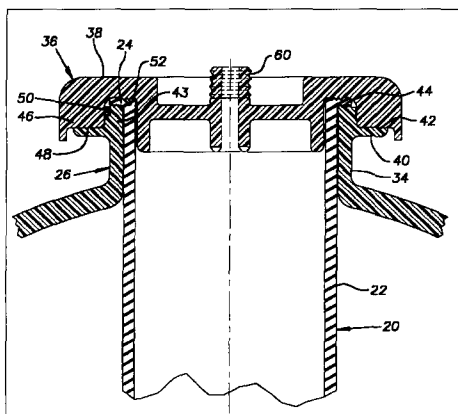


Figure 1: Cross section of the sealing portion of the pressure vessel.

In the rod seal assembly (Figure 2a), a bellows seal assembly (570) provides a leak-free seal that is located between the cylinder block (14) and the drive case (12). Furthermore, the design of the Stirling engine allows the replacement of the sliding contact rod seals with the bellows seal assembly without substantial reworking of the engine.

In the piston assembly (Figure 2b) two sealing rings (380 & 382) located on opposite sides of a sealing washer (370) are positioned between the base section and a dome section of the piston head. On the inside diameter of each sealing ring is a spring ring (384 & 386) which provide an outward bias to the sealing rings forcing them in contact with the cylinder bore; thereby providing gas sealing. During operation the sealing rings are alternatively urged into sealing contact with the cylinder bore as the piston reciprocates.

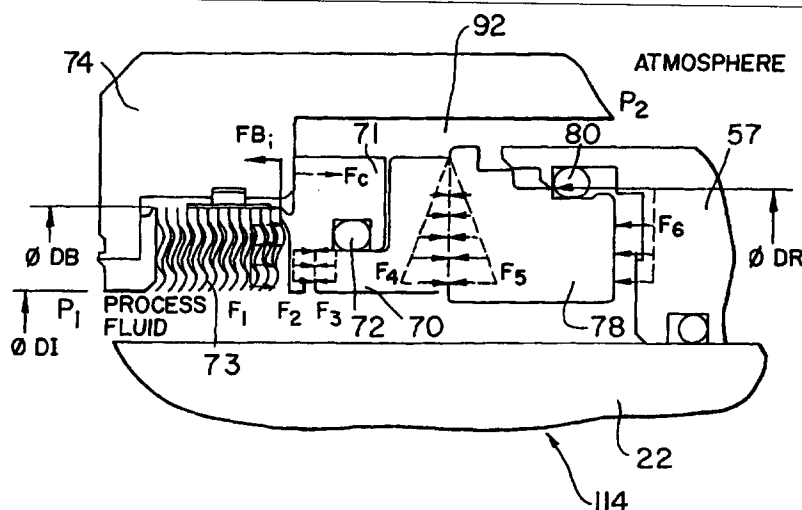


Figure 3b: The inboard seal under pressure reversal conditions.

Bellows prevents seal blowout

Title: Bellows seal with reverse pressure capability

Patent number: US5873574

Date: 23rd February 1999

Inventors: Ringer Y

Assignee: John Crane Sealol Inc.

Need:

Pumps, especially those in refineries and chemical plants, often have to handle difficult-to-seal liquids. Under these conditions the seal life expectancy is often short.

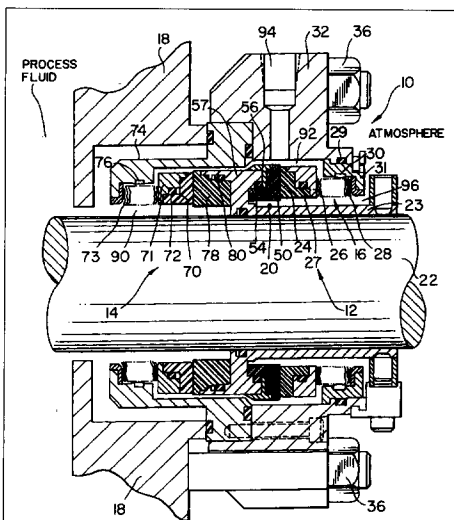
Non-contacting lubricated seals have been shown to possess significant benefits over contact

seals. They use a thin film of gas to separate the seal member faces during operation; thereby, reducing seal wear and heat generation due to friction. Commonly, an O-ring is used as a secondary seal, with springs acting as a bias against the opening of the seal faces, as well as maintaining seal face closure when not in operation. More recently, gas seals have incorporated bellows as a combined secondary seal and bias.

Under normal circumstances the buffer gas is at a higher pressure than the process fluid, which helps to prevent leakage through the non-contacting seal faces. However, if the buffer gas pressure suddenly drops below that of the process fluid, the gas seal can blow open, causing a high leakage of process fluid into the atmosphere. This situation is known as "pressure reversal."

Therefore, a need exists to develop a bellows non-contacting gas seal that can withstand pressure reversal.

(71). The gland (74) also applies a contact force (F_c) to the seal ring shell (71). Both F_1 and F_c act in the outboard direction. Furthermore, the process fluid pressure also acts on the opposing faces of the ring shell (71) and stationary seal ring (70) and the inner diameter of the O-ring (72). However, these forces (F_2 & F_3) are opposite and equal and cancel each other out. Similarly, the forces (F_4 & F_5) exerted by the process fluid between the seal faces cancel each other. The process fluid also exerts a force (F_6) on the back face of the rotating seal ring (78) and the O-ring (80), urging them in the inboard direction. The net value of the forces exerted by the process fluid is zero. However, the contact force (F_c) between the gland and the ring shell is greater than zero. Therefore, the rotating seal ring (78), stationary seal ring (70) and seal ring shell (71) move in the inboard direction until the shell ring (71) contacts the gland (74), closing the seal faces and preventing fluid leakage.

Figure 3a: Non-contacting bellows seal *in situ*.

Invention:

This present invention describes a mechanical seal assembly (Figure 3a) comprising an outboard noncontacting gas seal (12) and an inboard non-contacting gas seal (14), each possessing a stationary assembly (16) and a rotary assembly (20). The stationary assemblies are made up of a seal ring (24 & 70), a seal ring shell (26 & 71), secondary sealing O-rings (27, 29 & 72) and a bellows (28 & 73).

During normal operation, a buffer gas, preferably nitrogen, is supplied at a pressure above both atmospheric and process fluid pressure, ensuring no leakage of process fluid.

Under the situation of pressure reversal (Figure 3b) a force (FB_i) compresses the inboard bellows (73), with the process fluid applying a force (F_1) at the back-end of the seal ring shell

Moisture-responsive seal

Title: Seal arrangement for tubular tunnel segments

Patent number: US5888023

Date: 23th February 1999

Inventors: Grabe W, Glang S, Gutschmidt H,
Haye B

Assignee: Phoenix Aktiengesellschaft

Need:

In the majority of tunnel projects the segments comprising the tunnel are commonly sealed